OPTIMALIZATION DESIGN OF BEAM SHAPING ASSEMBLY AS A BNCT CANCER TREATMENT FACILITY USING D-T REACTION NEUTRON GENERATOR

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ABSTRACT

Boron Neutron CaptureTherapy has become a reliable method to overcome aggressive and metastatic cancer such as glioblastoma multiforme, lung cancer, etc., in which other adjuvant methods have failed to control its malignancies. Energy spectrum and epithermal neutron flux which fulfill standard IAEA requirements have become the most essential keys for the method to be successful. Thus, Beam Shaping Assembly (BSA) with particular material and geometry is required to moderate and direct beam with energy from fast neutron range to reach optimum epithermal and flux neutron range. As many studies related to BSA have been done, in this paper, optimization of the BSA has been performed with MCNP-X simulator to shape the 14.1 MeV neutrons that were produced by a D-T reaction neutron generator. Unlike uranium that used as multiplier to increase flux (Fatemeh et al., 2012 and Liu et al., 2014), this proposed system uses bismuth as recommended by Fatemeh, because uranium utilization will cause gamma radiation effect (Faghihi et al., 2013). Furthermore, the modeled neutron source is different with Faghihi's research in which the neutron source model is isotropic and mono-energetic, for as much reality approach. By optimalizing the thickness and diameter of the BSA, optimum result has been reached with combination of 10 cm Bi as a multiplier, 25 cm TiF_3 and 35 cm AlF_3 as moderators, Pb and Ni as reflector and collimator, 2 cm Fe as a neutron fast filter, 5 mm Li as a thermal neutron filter, and 3 cm Bi as a gamma ray filter. The produced of epithermal neutron flux is 6.79 x 10^8 n cm^{-2} s^{-1} and has not reached than 10^9, in which this result corresponds to the irradiation time applied at the time of treatment. The BSA design is still appropriate to be used for in-vivo and ex-vivo experiment in BNCT project facility for Indonesia as almost all standard IAEA requirements in air-parameter have been met. With the increased beam current of deuteron, optimum epithermal neutron flux for supporting cancer treatment facility is possible to reach.

Key Word: BNCT, Beam Shaping Assembly,D-T Neutron Generator